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IN THE UNITED STATES DISTRICT COURT  
FOR THE SOUTHERN DISTRICT OF OHIO  
EASTERN DIVISION AT COLUMBUS

CITIZENS AGAINST POLLUTION,  
Plaintiff,

vs.

Civil No.: 2:04-CV-00371  
Judge Gregory Frost  
Mag. Judge Mark Abel

OHIO POWER COMPANY,  
Defendant.

D E P O S I T I O N O F

WITNESS: STUART BATTERMAN, Ph.D. (Volume II)

LOCATION: Offices of Patricia Murray & Assoc.  
122 South Main Street  
Ann Arbor, Michigan

DATE: January 6, 2006

APPEARANCES:

FOR PLAINTIFF: BAILEY & GLASSER  
227 Capitol Street  
Charleston, West Virginia 25301  
BY: BENJAMIN L. BAILEY

FOR DEFENDANT: PORTER, WRIGHT, MORRIS & ARTHUR  
41 South High Street  
Columbus, Ohio 43125  
BY: MOLLY S. CRABTREE

Reporter: Karen Klerekoper, CSR-4250, RPR

Ann Arbor, Michigan

January 6, 2006

At 9:05 a.m.

STUART BATTERMAN

HAVING BEEN CALLED BY THE DEFENDANT AND SWORN:

EXAMINATION (Con't)

BY MS. CRABTREE:

Q. Good morning, Dr. Batterman.

A. Good morning.

Q. When we left yesterday, I believe we were on 2.3.6 on  
page 16 of your report. Go ahead and flip to that.

This is a section entitled Goals of Ohio

EPA Toxic Air Emission Policy Are Not Satisfied.

In here, you're talking about the MAGLCs,  
or MAGLCs, in Ohio; is that correct?

A. Yes.

Q. Are you aware of whether Ohio EPA has taken any  
measures to make the Gavin facility reduce its H2SO4  
or SO3 to the MAGLC levels?

A. I haven't seen any evidence to that effect.

Q. Are you aware of whether the MAGLCs are mandatory  
limits?

A. I understand that there is some debate whether or not  
they are a policy or a guideline.

98

100

## 1/6/2006 Batterman, Stuart Day 2

## I N D E X

WITNESS: STUART BATTERMAN, PH.D. PAGE NO.

Examination (Con't) by Ms. Crabtree 100

## EXHIBIT INDEX

EXHIBIT NO. DESCRIPTION PAGE NO.

(Exhibits not marked)

## 1/6/2006 Batterman, Stuart Day 2

Q. What would you consider the MAGLCs?

A. Based on the fact that it's called the Air -- it's  
called a policy, I would take it for what it is. But,  
in essence, it's, you know, an attempt to regulate a  
pollutant to provide a protective level for the  
population. And, of course, all state agencies have a  
degree of flexibility in how they interpret their  
policies and guidelines and, for that matter, how they  
interpret standards.

Q. Do you know how often Ohio EPA reviews this policy?

A. I haven't reviewed that information.

Q. Turning to 2.3.7, on this same page, which is entitled  
Emissions of SO3/H2SO4 Are Ongoing and the 2002  
Monitoring Data Remains Pertinent.

Again, where are those 2004 levels coming  
from that you cite here, this 10 to 15 parts per  
million, at both Gavin units?

A. I believe that these are values expressed as targets,  
more or less, for the Gavin units that were in  
materials that were prepared by Ohio Power. They were  
present in PowerPoints that we would talked about.  
They were present in depositions of Osborn that we  
also talked about yesterday.

Q. So these aren't coming from that Excel spreadsheet  
that we were talking about yesterday?

99

101

1 A. No, I don't believe they were.

2 Q. I think you answered this yesterday: Did you look at

3 any actual stack test data from 2004?

4 A. I have not seen actual stack test data for 2004.

5 Q. Do you think that the 2002 ambient monitoring data

6 that's summarized in your Table 1 are indicative of

7 current levels of ambient concentrations in the

8 Cheshire area?

9 A. I have to speculate on that because I have seen no

10 ambient monitoring data for 2004 and, to my knowledge,

11 none has been taken after 2002. So my speculation is

12 based on things otherwise as they were in 2002. In

13 that case, they would be representative.

14 Q. Have you seen any data that would indicate to you

15 things have changed since then?

16 A. Since when?

17 Q. Since 2002.

18 A. Are we referring to 2006, 2004, 2005?

19 Q. Anything since 2002 that would indicate to you that

20 the 2002 data may not be relevant?

21 A. Sure. For example, in 2002, only one of the SCRs was

22 operating, and in subsequent years, both of them were

23 operating. I think in 2003, only one of them was

24 operating, but 2004 to the present, I believe both are

25 operating.

102

1 Operation, as well known, SCRs will

2 increase the quantities, the emission rates, of

3 sulfuric acid precursors, SO<sub>3</sub>. So if the emission

4 rates went up, then ground-level concentrations have a

5 good likelihood of going up, since, as I indicated to

6 you the other day, concentrations can be proportional

7 to emissions.

8 Q. Moving on to page 17, which begins section 2.4 of your

9 report, discussing exposure in the Cheshire community.

10 The first question for you is, you say that

11 the plant is just a few yards from the road, do you

12 actually know how far that is?

13 A. Well --

14 Q. Do you see where I am?

15 A. No, I don't.

16 Q. I'm sorry. It's right above 2.4.2, the paragraph that

17 starts, "Beyond exposures." It's the last sentence in

18 that paragraph.

19 A. Yeah. Well, I have driven down that road and,

20 essentially, the road abuts the facility and, I

21 believe, in fact, the Gavin plant has unloading

22 facilities from the river on the opposite side of the

23 road. So, essentially, the road doesn't drive through

24 the property. I don't believe they own the roadway,

25 but it's abutting.

103

1 Q. Okay. Do you know approximately how far the stacks

2 are from the actual road?

3 A. I don't have a distance for you in meters, but it's a

4 short distance. I have examined aerial views and I

5 just don't have a recollection of how many meters or

6 feet it is.

7 Q. Fair enough. In your 2.4.1, entitled Individuals Live

8 in High-Exposure Areas, you reference from Table 6 in

9 your report. If we could turn to that, please. It's

10 on page 26.

11 Why did you choose just these 17 individual

12 residences?

13 A. These were the CAP members whose names and addresses I

14 was given. These were the extent to my knowledge of

15 the CAP members who had provided that information.

16 Q. Do you know if this is all the CAP members or just a

17 subset that you were given?

18 A. I do not know that for sure.

19 Q. Okay. Under distance, that's kilometers from the

20 Gavin stacks or the Gavin property?

21 A. I think what I did here was to calculate the distance

22 between the midpoint of the Gavin stacks.

23 Q. Between the two stacks side by side?

24 A. I calculated what we would call the midpoint, or the

25 centroid, the point right in between the two, and I

104

1 believe I calculated distances from that --

2 Q. Okay.

3 A. -- that location. I think I've probably described

4 that somewhere.

5 No, I just said from the Gavin facility

6 stacks. Since the stacks are relatively close

7 together, it's probably within the margin of error.

8 Q. There are two residences in your Table 6 that are less

9 than 2 kilometers from that midpoint measurement; is

10 that correct?

11 A. That's what I found.

12 Q. Did you use these distances to calculate an exposure

13 risk to these residences based on the distance from

14 the stacks?

15 A. Not directly.

16 Q. In the second nonitalicized paragraph in 2.4.1 --

17 A. Which page, please?

18 Q. I'm back on 17. It starts out, "The CAP members'

19 residences." You have -- according to your Screen 3

20 dispersion model, the maximum ambient concentration

21 occurred at downwind distance of about 1.24 kilometers

22 downwind.

23 There are no residences listed in your

24 Table 6 that are that close to that plant, correct?

25 A. The closest residence is approximately 1.4 from the

105

1 midpoint, given the plus or minus that I indicated  
 2 before, were in that same realm of distance.  
 3 It's also, I think, understood with  
 4 my -- with follow-up to the sentence that you have  
 5 identified that, in fact, distances are -- I'm sorry,  
 6 concentrations change only slightly as you move to  
 7 slightly longer or slightly shorter distances.  
 8 Q. You have here the ambient concentration at 1.4  
 9 kilometers, which would be the closest residence in  
 10 your Table 6, is only about 5 percent lower at this  
 11 distance?  
 12 A. That's correct.  
 13 Q. What about the residences -- there are 2 residences,  
 14 here at the top of your Table 6, which are 6.6  
 15 kilometers away. What would you expect the ambient  
 16 concentration to be at that distance?  
 17 A. I think your question is asking me, if you could  
 18 clarify, what is the concentration that I would expect  
 19 Screen 3 would provide?  
 20 Q. Yes.  
 21 A. I don't know. I don't memorize the numbers that come  
 22 out of a model like that.  
 23 Q. You say they go down by 5 percent when you go to 1.4  
 24 kilometers. Did you see by how much those predicted  
 25 levels went down as you got further and further away

106

1 from the plant?  
 2 A. Yes. Screen 3, in conventional application, using  
 3 what is called an automatic distance array, in other  
 4 words, it calculates concentrations at a variety of  
 5 distances from -- I think I ran it from 100 meters to  
 6 10 kilometers -- will essentially calculate the  
 7 concentrations at roughly 50 distances in between  
 8 those two end points.  
 9 And I looked at what the concentration was  
 10 at intermediate distances, for example, residences for  
 11 Rose Gilles at 6.6, but I just don't recall. It's in  
 12 the printout of the model. And the point here, in a  
 13 typical application of Screen 3, is to look at worst  
 14 case. I didn't look at -- focus my attention on  
 15 distances beyond the worst case.  
 16 Q. But those distances would be in the Screen 3 results  
 17 in your work papers?  
 18 A. In the model output, yes.  
 19 Q. Okay. Back on 17, the next paragraph down, you have:  
 20 Also of concern are detections of the H2SO4 plume at  
 21 locations of sensitive or vulnerable populations. And  
 22 you talk about the River Valley School and the  
 23 potential for exposure for children on their way to  
 24 school, children who are exercising and children  
 25 engaged in sports where they may spend considerable

107

1 time outdoors.  
 2 Did you make any attempt to correlate the  
 3 timing of plume touchdowns with when those children  
 4 might be on their way to school or outdoors?  
 5 A. In general, the data don't permit that determination.  
 6 The monitoring, as we talked yesterday, was sporadic,  
 7 daylight hours. It's in the first, say, phase from  
 8 2001 to over the 2001 period. Averaging times were  
 9 basically daylight hours, six to eight hours,  
 10 typically.  
 11 You could not determine from a plume  
 12 detection during the 2001 monitoring whether that  
 13 would have occurred at a noon recess, whether it would  
 14 have occurred when the students were inside. That  
 15 information was not available from the 2001 data.  
 16 From the 2002 data, the sampling times were  
 17 not always specified and, thus, I wasn't able to make  
 18 that determination either.  
 19 In any event, as I talked about, my opinion  
 20 regarding the adequacy of the monitoring is that that  
 21 would not be a reliable determination.  
 22 Q. Okay. You talk about the children being outdoors. Is  
 23 it generally true that if you were indoors, you have  
 24 less of an exposure to ambient concentrations of  
 25 H2SO4?

108

1 A. That would be my expectation. I would say that there  
 2 has been very little monitoring indoors of H2SO4, and  
 3 the expectation is, yes, that there would be  
 4 attenuation indoors, especially if windows were closed  
 5 and air conditioners were on, so forth.  
 6 If the windows were open and there is a  
 7 breeze present, and so forth, the attenuation would be  
 8 reduced and exposures indoors would be higher.  
 9 Q. The last paragraph in this section starts, "Beyond  
 10 exposures at home or in schools, CAP members and other  
 11 community members may" --  
 12 A. I'm sorry, which section are you?  
 13 Q. The last paragraph in 2.4.1.  
 14 -- "may have exposure to H2SO4 plume at  
 15 other locations where they may work, drive through or  
 16 recreate."  
 17 A. Yes.  
 18 Q. When you are driving along Route 7 near the Gavin  
 19 plant, the Kyger Creek and Gavin plants are quite  
 20 close together, correct?  
 21 A. They are within a few miles, yes.  
 22 Q. The CAP members are actually describing symptoms and  
 23 smells while driving along Route 7; is that your  
 24 recollection?  
 25 A. A number of the reports from community members were

109

1 while driving, that's correct.

2 Q. Let's go ahead and look at Table 7, which details some

3 of these complaints. It's on page 27 of your report.

4 Now, first one of the individuals you have

5 listed here is Stinson. Do you know if that's Paul or

6 April Stinson?

7 A. No, I can't say for certain because many of these are

8 e-mails, and I don't recall whether it was signed Paul

9 or April.

10 Q. You don't have any specific documents cited for this

11 table summary. Do you know where you got all of

12 these?

13 A. Yeah, I think most of these were in interrogatories

14 that you have. They were also in e-mail evidence as

15 well. That was provided electronically.

16 Q. Did you ever look at the handwritten diaries of the

17 CAP members?

18 A. I have seen some handwritten materials, but I don't

19 know that I would consider them diaries.

20 Q. What do they look like?

21 A. To my recollection, they look like they were on a pad,

22 but I don't recall the details beyond that.

23 Q. Okay. So this -- these are complaints from two,

24 perhaps three, different people then?

25 A. Well, I'm not sure how many because Stinson could

110

1 represent one or the others. Mulford is another

2 individual. I'm not sure if it's a wife, husband,

3 child, whatever. Several members, in any event.

4 Q. Probably five, or less?

5 A. My guess is that's correct.

6 Q. Okay. They detail some symptoms here. One of the

7 first ones I see is a sulfur odor or sulfur taste.

8 Would you associate a sulfur odor or sulfur

9 taste with sulfuric acid mist?

10 A. Well, I'm not probably able to judge how someone else

11 characterizes an odor or a taste.

12 We know that olfactory response is very

13 subjective, and people have different descriptors.

14 These individuals have not been trained to

15 characterize odors, and the way they characterize it

16 is, as I indicated, subjective. So I would not rule

17 out a sulfur odor and burning in a nose, and so forth,

18 as an inappropriate descriptor for an untrained

19 individual.

20 Q. Looking at these types of symptoms, is there anything

21 else that could cause these kinds of symptoms?

22 A. Taken in isolation, there are other factors that could

23 cause these symptoms.

24 Q. What would those factors be?

25 A. Nothing specifically comes to mind because I think,

111

1 taken in isolation, it seems pretty unlikely that you

2 would have burning in nose and lungs or an odor as you

3 drive past a facility that would likely be caused by

4 something other than the sulfuric acid plume.

5 Taken in isolation, clearly you can get

6 burning in your eyes if you've just eaten some spicy

7 food or put your fingers in your eyes after touching

8 an irritant, or something like this. So these are

9 general irritant symptoms, and a number of factors can

10 cause irritation.

11 Q. But you are saying in driving past a facility such as

12 Gavin, you can't think of any other cause for these

13 symptoms, other than the sulfuric acid mist?

14 A. No. I said it appeared to me to be unlikely, in my

15 opinion, that other factors would cause this kind of

16 response.

17 Q. I noticed in your resume, you have done some work with

18 particular emissions from motor vehicles. If one of

19 these individuals was driving by the plant in an

20 open-top Jeep, is there anything in the vehicle

21 emissions that might cause these symptoms?

22 A. An individual is driving in a open-top Jeep?

23 Q. Uh-huh.

24 A. In a properly operating vehicle, the emissions from

25 that vehicle are discharged through the tail pipe at

112

1 the rear of the vehicle, and occupants shouldn't be

2 exposed to very much of that. So I would suspect that

3 the open-top Jeep would not produce a pollutant that

4 the vehicle operator was having a particular problem

5 with. Most people, when they have exhaust leaks, and

6 so forth, would get that repaired. Certainly you can

7 have exhaust leaks that make their way into the

8 passenger cabin.

9 Q. If you are in an open-top Jeep closely following

10 another vehicle, would you expect any of these

11 symptoms as a result of the emissions from the vehicle

12 in front of you?

13 A. Vehicles in front of you have been noted to produce

14 concentrations within trailing vehicles. Whether or

15 not it's open is probably not that significant of an

16 issue.

17 Q. Would those emissions from the vehicle in front of you

18 potentially cause any of these symptoms?

19 A. I think it's unlikely in most cases that

20 properly operating vehicles would cause burning in

21 nose and throat, lungs, and severe irritation symptoms

22 for most individuals.

23 Q. Did you ask to see any medical record for the

24 complainants of these symptoms?

25 A. I asked whether there were medical records available.

113

1 Q. What was the response?

2 A. I don't believe that medical records were available.

3 Q. Did you talk to any of them?

4 A. Talk to any of them, being who?

5 Q. Any of the people making these symptom complaints.

6 A. I met Mr. Stinson and chatted with him.

7 Q. Did you talk to him about his health complaints?

8 A. I think our conversation included his health

9 complaints.

10 Q. What were Mr. Stinson's health complaints?

11 A. In the context of discussion, was very similar to

12 what's been described in the report here. He

13 described his -- the perceptions that he had when he

14 believed he was exposed to -- when he would determine

15 what he would call the blue plume.

16 Q. If there were medical records for these people

17 complaining of these symptoms, would you consider them

18 relevant to your analysis?

19 A. It would be helpful.

20 Q. Do you find it unusual that your Table 7 only includes

21 a small number of people, we're both guessing five or

22 less, based on the two last names?

23 A. Do I find it unusual? No, not really.

24 Q. Why?

25 A. Well, a couple of the reasons, I guess. First of all,

114

1 my understanding is that this is a company town and

2 employees who are working for the firm, or who have

3 connections for the firm, are quite hesitant to speak

4 up. The town is relatively small. We have a

5 population size, and in a population, you only have so

6 many people who are willing to participate.

7 Sensitivities of individuals vary and, for

8 example, in a town you might have so many children and

9 only a percentage of those children, for example,

10 would have asthma. And of those asthmatics, perhaps

11 only a percentage of those would respond to plumes.

12 So there are a number of factors that tend

13 to reduce the number of people who respond. I suspect

14 a lot of individuals who had problems dealing with

15 conditions -- and this is all speculation for me --

16 have left the town, were bought out. So it's not too

17 surprising that the sample size in my table is small.

18 Q. I notice that the earliest complaint in your table is

19 April of 2003. Do you know why you didn't have any

20 earlier complaints?

21 A. I didn't actually attempt to provide a complete

22 chronological record of complaints. My intention in

23 this table was, in part, to show that there is a

24 continuing problem that have community members

25 responding and making complaints. I anticipated that

115

1 the earlier record is fairly similar, but I don't

2 recall in detail what that looks like.

3 Q. Okay. Do you know whether any of these people in your

4 Table 7 have asthma?

5 A. I'm not certain. I forget. I know that there are

6 individuals in the community that have asthma.

7 Q. But you are not sure if it's any of these individuals?

8 A. I'm not sure if it's any of these.

9 Q. What about allergies?

10 A. I am not sure about that either.

11 Q. So is it fair to say, you are not familiar with the

12 personal medical histories of the people listed in

13 Table 7?

14 A. That's a fair characterization.

15 Q. Okay. How do you differentiate between symptoms

16 caused by the Gavin SO3/H2SO4 emissions versus other

17 ambient sources of SO3 or H2SO4?

18 A. In general, I think I would look for the

19 correspondence between factors that would indicate

20 that the Gavin facility is producing the exposures.

21 And the concordance or simultaneity or near

22 simultaneity from health responses from individuals in

23 that community. Is that too technical?

24 Q. I'm looking at it now.

25 A. I would also look for the likelihood of exposures from

116

1 other sources that might produce H2SO4, or other types

2 of irritants, and I would look at the totality of the

3 complaints. In other words, not just look for cough

4 but look for cough and irritation, other things that

5 might help identify or confirm that the Gavin facility

6 is the responsible agent.

7 Q. Did you, in fact, do that?

8 A. Well, it's difficult to do that, for a number of

9 reasons. First of all, there is not much of a

10 monitoring basis to determine whether there is an

11 exposure of H2SO4, sulfur, nitrogen, or whatever else.

12 Second, the record is relatively limited in

13 the monitoring, as I indicated, as well as at the

14 emission side of things. I don't have the record of,

15 say, day-to-day, hour-to-hour emissions or, for that

16 matter, touchdowns or events that might produce higher

17 concentrations. So it's a difficult task to do.

18 However, as I looked at sources in the area

19 for irritant gases like H2SO4, and the proximity of

20 these CAP members to the Gavin facility, it seems

21 unlikely, in my opinion, that there is a significant

22 alternative explanation.

23 Q. Did you look at any data on emissions prior to 2001

24 from the Gavin facility?

25 A. For H2SO4?

117

1 Q. Yes.

2 A. I don't recall looking specifically for -- I think I

3 did look briefly for the TRI database, and I just

4 don't recall what was in there.

5 Q. Did you check to see if there were any symptom

6 complaints prior to 2001 similar to those in your

7 Table 7?

8 A. I was given some information with symptom complaints,

9 but I don't recall whether they preceded 2001.

10 Q. When I say "2001," because that's when the SCRs

11 started, in the spring of that year.

12 A. That's right.

13 Q. Do you have any opinion as to the potential impacts of

14 H<sub>2</sub>SO<sub>4</sub> emissions prior to 2001?

15 A. I'm sorry, potential impacts?

16 Q. Potential health impacts.

17 A. Of sulfuric acid?

18 Q. Prior to 2001.

19 A. Yeah. I mean, sulfuric acid is sulfuric acid. It

20 doesn't matter whether people haven't changed in two

21 years. You are talking about the emissions from

22 Gavin, I assume?

23 Q. Yes.

24 A. Okay. As well understood in combustion, there will be

25 some sulfuric acid produced during a combustion coal

118

1 without the SCRs, and this was referred to as pre-SCR

2 levels, I believe. And those concentrations are on

3 the order of single digit, typically, in the flue gas

4 effluent.

5 So there's certainly emissions of H<sub>2</sub>SO<sub>4</sub>

6 from Gavin beforehand. But it's also well understood

7 that introduction of SCRs provided substantial

8 increases in H<sub>2</sub>SO<sub>4</sub> emissions.

9 So prior to 2001, there certainly were

10 emissions of H<sub>2</sub>SO<sub>4</sub> but at levels that were a fraction

11 of what we saw in 2001.

12 Your question, I think, is it my opinion

13 that those concentrations of H<sub>2</sub>SO<sub>4</sub>, prior to

14 installation of SCRs, is cause to health effects? Is

15 that your question?

16 Q. Yes.

17 A. The answer, I think, I would have is that, yes, it

18 could possibly, along with the other pollutants

19 emitted from the facility, be involved in adverse

20 health effects.

21 Q. Back to page 17 of your report, I'm looking at section

22 2.4.2 entitled Individual Symptomatology is Consistent

23 With Exposure to the H<sub>2</sub>SO<sub>4</sub> Plume.

24 In the italicized portion of this, you say:

25 The record of complaints from CAP members regarding

119

1 odor, irritation, coughing and breathing difficulties

2 most associated with sightings and local touchdowns of

3 the Gavin plume is consistent with exposure to high

4 concentrations of H<sub>2</sub>SO<sub>4</sub>.

5 Do you know if those individuals reporting

6 the symptoms were actually in a visible plume

7 touchdown?

8 A. Well, my recollection is that some of them said: I

9 drove through the plume and my eyes started to hurt,

10 and so forth.

11 Based on that, I would assume some of them

12 were immersed, I guess you could say, in the plume.

13 In other cases, people would say: I saw a

14 touchdown and it moved this way, and it covered the

15 area.

16 In that case, I guess I would assume that,

17 yes, they were again within the plume, in quotes.

18 Q. Speaking about a visible blue plume, does there need

19 to be a visible plume for there to be a health risk to

20 individuals?

21 A. No. In fact, there doesn't need to be necessarily the

22 perception that they have irritation as well.

23 Q. What do you mean by that?

24 A. Irritation has been often regarded as a canary. So

25 the canary dies, you know you have a problem in the

120

1 coal mine. But, in fact, there can be health effects

2 that occur below levels at which individuals perceive,

3 and that's well understood with this particular

4 contaminant.

5 Q. Those health effects that can occur below a perceived

6 level, are those permanent health effects?

7 A. They can be.

8 Q. What are the permanent health effects that did occur

9 below a perceived level of irritation?

10 A. Well, for example, you won't smell formaldehyde, but

11 formaldehyde below a certain level you won't smell it,

12 but below a certain level it's associated with cancer.

13 Q. What about with H<sub>2</sub>SO<sub>4</sub>?

14 A. H<sub>2</sub>SO<sub>4</sub>, based on fairly robust, in concordance with

15 literature and clinical studies, is associated, as I

16 state in section 2.5, a number of respiratory effects,

17 including lung function, particle clearance, and so

18 forth.

19 Q. Okay. You had talked about irritation being regarded

20 as a canary and that there could be permanent health

21 effects below a detectable irritation. What are those

22 permanent health effects associated with sulfuric acid

23 that would occur below a level of irritation?

24 A. Well, as I indicated, that there can be changes in

25 pulmonary function. There can be changes in

121

1 clearance. There are likely to be secondary impact  
 2 from that, for example, greater sensitivity to cope  
 3 with other pollutants exposures, or subsequent  
 4 pollutant exposures.  
 5 Q. Are all of those permanent symptoms or transitory  
 6 symptoms?  
 7 A. It's unclear in some ways. Lung function, for  
 8 example, can often rebound. On the other hand, the  
 9 effect of having an exposure in terms of other health  
 10 end points is unclear. The effect of repeated  
 11 exposures is also unclear.  
 12 Q. Let's go ahead and move to 2.5, since we seem to be  
 13 talking about it anyway. Health effects of H2SO4.  
 14 I'm looking at 2.5.1, on page 18. The first  
 15 nonitalicized paragraph there says: Numerous studies  
 16 have shown adverse health impacts with low to moderate  
 17 concentrations of H2SO4 and acute duration exposure  
 18 studies in both humans and animals.  
 19 You go through in the rest of this section  
 20 and detail some of those.  
 21 I didn't see any animal studies in the  
 22 studies that you list in your report. Is there a more  
 23 comprehensive list of those studies, other than what  
 24 you specifically cite in the text of your report?  
 25 A. Yeah. I think that, in fact, somewhere I cited that

122

1 ATSDR provided a review. One of your experts working  
 2 at Gradient Corp in 2002 provided a review. And he's  
 3 altered some of that in his expert report of 2005 as  
 4 well.  
 5 There is reviews in the TLV documentation  
 6 for this pollutant. There are reviews in some of the  
 7 other documents that I have cited. It wasn't my  
 8 opinion -- rather, my task here to review all of that  
 9 information.  
 10 Q. So you looked at these reviews of the relevant  
 11 literature. You didn't necessarily look at each of  
 12 those underlying studies in those reports?  
 13 A. No. I also reviewed a number of those reports, and  
 14 you deposited -- rather, you requested my documents, and  
 15 some of the studies are provided there. And in some  
 16 cases, I went back to the pre-electronic age and got  
 17 some of the early studies that were only available,  
 18 rather fragile journal volumes hidden in the library  
 19 somewhere.  
 20 Q. You mentioned the 2002 Gradient report. Did you  
 21 consider that a reliable review of the literature?  
 22 A. I didn't really make an opinion whether it was  
 23 reliable or not.  
 24 Q. But you did cite it several times in your report, so  
 25 did you consider -- if you cited it in your report,

123

1 would you consider it unreliable?  
 2 A. I don't recall exactly where I cited it. It would  
 3 help to see that.  
 4 Q. I had that. It's on 17, first paragraph under 2.5.  
 5 You had cited it here on --  
 6 A. Yes, I see. That's just a fact that it's a review  
 7 there that attempted to update the ATSDR. My opinion  
 8 as to whether it's reliable, was that your question?  
 9 Q. Yes.  
 10 A. It provided some additional references, and I reviewed  
 11 those references, and my opinion is really that it was  
 12 useful for discussing the more recent literature,  
 13 particularly in terms of identifying additional  
 14 studies.  
 15 Q. Okay. You also cited as a source in your Table 1 on  
 16 page 23, in there, I think it's actually in the  
 17 footnote there. It says: Location inferred from  
 18 Gradient 2002. Then you listed again as a source for  
 19 that table.  
 20 A. This has nothing to do with the health effects. This  
 21 has to do only with locations, I believe.  
 22 Q. Okay. That answers my question, then.  
 23 Back on page 18, midway through the first  
 24 nonitalicized paragraph, the sentence starts, "This  
 25 has been demonstrated in individuals" --

124

1 A. I'm sorry, I don't see where you are.  
 2 Q. Fourth and fifth lines into the first nonitalicized  
 3 paragraph: Exercising asthmatic children have shown  
 4 adverse health effects to H2SO4 at concentrations of  
 5 70 micrograms per cubic meter.  
 6 A. Yes, I see that.  
 7 Q. How many studies did you review show clinically  
 8 noticeable results at 100 micrograms per cubic meter  
 9 or less?  
 10 A. I don't recall the numbers of studies. I mean, there  
 11 are not many studies of exercising asthmatics, that is  
 12 certainly the case.  
 13 Q. Would you say less than 10 studies show clinically  
 14 noticeable results at less than 100 micrograms per  
 15 cubic meters?  
 16 A. I'm don't think there have been even 10 studies that  
 17 have looked at very low concentrations of H2SO4.  
 18 Q. So it would be less than 5?  
 19 A. Yes.  
 20 Q. And the size of the aerosol makes a difference in  
 21 whether the symptoms will occur; is that correct? I'm  
 22 looking at the second to last line in that same  
 23 paragraph. You talk about the factors influencing the  
 24 health responses.  
 25 A. Yes.

125

1 Q. What do you mean by the size of the aerosol?

2 A. Atmospheric aerosols can be characterized by a number

3 of properties. One of them is the size, and it's well

4 understood that the size determines the penetration of

5 the aerosol into the airways and down into the lung.

6 Q. Do you have any opinion as to the size of the aerosol,

7 the H<sub>2</sub>SO<sub>4</sub> aerosol, emitted from the Gavin stacks?

8 A. Well, it's not been characterized before. It's a

9 difficult measurement to make. It can be made.

10 The size distribution is likely to be what

11 aerosol scientists would characterize as

12 polydispersed. In other words, it's a range of sizes.

13 Q. How would you go about characterizing the size of the

14 aerosol?

15 A. Well, I haven't thought about this. The typical ways

16 of capturing sizes of aerosols include devices from

17 impacters to -- to more sophisticated particle sizers,

18 and so forth. This is an area of very active research

19 right now in trying to characterize the health effects

20 of PM<sub>10</sub>, PM<sub>25</sub>, ultrafines, and so forth.

21 Characterizing them for this aerosol is

22 particularly challenging because it's quite dynamic

23 and can change in time. The aerosol is quite fragile.

24 It's quite reactive. And so a lot of these techniques

25 might not work very well. So I don't have the answer

126

1 for you on how I would do it today. It would be a

2 research project.

3 Q. When you say it is quite reactive, what do you mean by

4 that?

5 A. Well, it's a very soluble aerosol. So the presence of

6 a surface, for example, that might be used could

7 affect the results that you get.

8 This is why, for example, when you are

9 trying to determine exposures to acidic aerosols, you

10 typically try to use things like denuders to remove

11 caustic or basic constituents in the atmosphere that

12 might neutralize the acid. It's just a technical

13 challenge to do it for this particular aerosol.

14 Q. What is your understanding of why the plume is blue

15 sometimes?

16 A. It's a combination of absorption and refraction of the

17 aerosol with incoming light and the angle, and so

18 forth, of the observer with respect to the incoming

19 light, and the location of the particles.

20 Q. Is it in part due to water vapor clinging to the

21 sulfuric acid particles?

22 A. Well, the water vapor will -- I don't know if the term

23 is "cling" that I would use, is -- is important in

24 understanding the aerosol and, yeah, it's probably a

25 certain humidity range would affect the blueness, if

127

1 you will, of the plume, although I haven't

2 seen -- this is speculation on my part because I

3 haven't seen any scientific studies that really show

4 the effect of water vapor with respect to the blue

5 plume.

6 Typically, there is enough water vapor to

7 produce H<sub>2</sub>SO<sub>4</sub> from the emissions of sulfur trioxide.

8 The effect of the additional water vapor is unclear to

9 me.

10 Q. Would you expect any of the H<sub>2</sub>SO<sub>4</sub> aerosol to be

11 submicronmeter?

12 A. In diameter?

13 Q. Yes.

14 A. A possibility, as I indicated, that it is a

15 polydisperse size distribution.

16 Q. Do you have any opinion as to what portion of it would

17 be submicronmeter in diameter?

18 A. I haven't seen evidence that indicates that proportion

19 in a reliable manner.

20 Q. I'm looking at the second nonitalicized paragraph in

21 2.5.1, five lines from the bottom of that paragraph,

22 you reference a conference -- a concentration of 120

23 micrograms per cubic meter, and then a reference,

24 these levels are approximately twice those that cause

25 adverse health effects, increased respiratory

128

1 resistance in the previously cited ATSDR report.

2 Is that the 70 micrograms per cubic meter

3 study of asthmatic children that you referenced above?

4 I'm not sure which portion.

5 A. I think it is. I think for some reason number 66

6 micrograms sticks in my mind as well, but 70 is close

7 to that, so it could be the same one.

8 Q. But 120 micrograms per cubic meter isn't twice the

9 level of most of the studies that you looked at that

10 cause clinically significant effects?

11 A. No. As I stated, these are approximately twice.

12 There is a plus or minus in all of these measurements.

13 Q. You said these measurements are approximately twice.

14 I'm saying is the 120, approximately, twice the levels

15 that you saw in other studies, other than the one with

16 the asthmatic children?

17 A. I don't recall. There have been a couple of studies

18 looking at levels below 100. I selected this one

19 because it was useful in that it incorporated

20 asthmatics as subjects.

21 Q. But most of the studies looked at concentrations

22 greater than this 120 microgram per cubic meter; is

23 that correct?

24 A. My -- yeah, my recollection is that most of them are

25 looking at higher concentrations, and also not at

129



1 asthmatics and not at children.  
2 Q. Okay. The last paragraph in this section, last  
3 sentence of that, you say: Since the odor threshold  
4 exceeds the level at which adverse health effects  
5 occur, odor does not serve as a reliable warning to  
6 individuals who might be exposed.

7 What kind of warning do you think  
8 individuals need if concentrations are below 1,000  
9 micrograms per cubic meter?

10 A. Well, in fact, at the end of this report, I talk about  
11 types of warnings that might be used, and these are  
12 provided, I think, in section 2.6.2.

13 Q. So these are the same warnings?

14 A. No. You asked -- your question was what types of  
15 warnings. I'm trying to answer your question.

16 The types of warnings might be to provide  
17 sirens, to provide -- what do you call it -- telephone  
18 SMSs, whatever we call them, things like this, similar  
19 to what we do for ozone alerts, and so forth.

20 The warning would say: As we practice now  
21 via a number of mechanisms, including radio,  
22 television, e-mails even, to individuals in Michigan,  
23 perhaps in Ohio, elsewhere -- I'm not sure -- this is  
24 not a good day to exercise outdoors, limit your  
25 activities outdoors, that sort of thing. This is not

130

1 uncommon for ozone. And it's directed primarily at  
2 asthmatics, although others are sensitive to effects  
3 of pollutants.

4 Q. So the warnings you are talking about here are the  
5 warnings you are talking about in section 2.6,  
6 correct?

7 A. No. I didn't, in fact, in this paragraph, try to  
8 extrapolate to the application of these warnings,  
9 which is what 2.6 does. Here I'm simply stating that  
10 in this case, odor does not operate as a canary.

11 Q. Okay. Turning to 2.5.2 of your report entitled  
12 Occupational Exposure Limits For H2SO4 Are Approached  
13 and Likely Exceeded in the Cheshire Community.

14 You note, first off, it should be noted  
15 that occupational guidelines and standards are  
16 designed for the occupational setting and, thus, may  
17 not be protective for the general public.

18 Isn't it true, though, that occupational  
19 standards are designed for exposure eight hours a day,  
20 five days a week, for an approximate work life of 25  
21 years?

22 A. All those are, in fact, approximate. I think if you  
23 go into the history, you will see six hours or eight  
24 hours or ten hours, depending on the time, because  
25 these things have been around since, I don't know, for

131

1 decades.

2 The work life has also not actually been  
3 stated explicitly recently, so I don't know that it's  
4 approximately 25 years or approximately more or less.

5 Q. You think that those levels of exposure are not as  
6 protective of the community as the community standard?  
7 Let me ask that in a better way.

8 A. I can answer that.

9 Q. Go ahead.

10 A. Reading on in the paragraph, this was noted decades  
11 ago in the 1974 recommendations from NIOSH. They said  
12 they were not designed for the population at large and  
13 any extrapolation, and so forth, is not warranted.

14 This applies in general to other  
15 contaminants that may have exposure limits or  
16 guidelines. This is not a surprise to any health  
17 professional. I can give you examples where limits in  
18 the occupational setting are reduced by substantial  
19 fractions to provide protection of the community at  
20 large.

21 Q. I think you do that later on in your report.

22 A. I don't think I did.

23 Q. Talking about the California REL?

24 A. No.

25 Q. What's an example, then, where they were --

132

1 A. For example, the current occupational limit for sulfur  
2 dioxide, which is perhaps the best study and well  
3 characterized, gas in the occupational setting is 5  
4 ppm for the 8-hour exposure that you were just  
5 discussing. Whether it applies for 40 hours in 25  
6 years, is fine. I will take that.

7 So the limit is 5. I believe that NIOSH  
8 has a TLB of 2, a little more protective than what  
9 OSHA enforces. But the SO2 National Ambient Air  
10 Quality Standard, which is designed to provide  
11 protection to the public, is set, I believe, at 0.03,  
12 which is on the order of 100 times or several hundred  
13 times lower than what the occupational standard is.

14 Q. Is that because individuals in the community are there  
15 24 hours a day?

16 A. In part, but that doesn't explain the magnitude of the  
17 difference entirely. In fact, it hardly explains.

18 Q. What explains the difference?

19 A. A number of factors: Occupational standards are  
20 designed for typically healthy workers. They are  
21 designed for workers who are dealing with a relatively  
22 limited number of simultaneous co-exposures.

23 They are designed to protect -- I'm sorry,  
24 the ambient standards would be designed to protect  
25 vulnerable, susceptible individuals; for example,

133

1 pregnant women, asthmatics, HIV or immunocompromised  
 2 individuals, so forth. So there are additional  
 3 reasons that have been quite well developed and  
 4 explained in the literature that can help explain the  
 5 more protective -- or, rather, the lower levels that  
 6 are used for protection of the general public as  
 7 compared to workers in occupational settings.

8 Q. I'm looking at the first paragraph on page 19. You  
 9 talk about the ACGIH exposure limits. That's the  
 10 American Conference of Governmental Industrial  
 11 Hygienists.

12 You reference in 1989 that a short-term  
 13 exposure limit or ceiling of 3,000 micrograms per  
 14 cubic meter for a 15-minute period.

15 Is that short-term exposure limit still  
 16 there in the ACGIH materials?

17 A. I don't recall for sure. I'm just citing what they  
 18 did in 1948.

19 Q. Do you know if there is a short-term exposure limit?

20 A. For H2SO4?

21 Q. Yes.

22 A. My mind is blanking this morning on me. I should have  
 23 stated it in here, and reading down -- and this  
 24 paragraph, ACGIH revised it, as you can read.

25 Q. Uh-huh.

134

1 A. The previous limits were assigned as STELs, short-term  
 2 exposure limit, is now 3,000.

3 Q. Right. Then there is another revision in 2004, which  
 4 you reference in the next paragraph. But you don't  
 5 reference the short-term exposure limit in that. I  
 6 just wondered if that meant that the short-term  
 7 exposure limit is still 3,000 micrograms per cubic  
 8 meter?

9 A. I just don't recall whether they revised. I recall  
 10 the document in detail, but I just don't recall that  
 11 specific.

12 Q. Did you see any data that would indicate to you that  
 13 there was an exceedance of a short-term exposure limit  
 14 of 3,000 micrograms per cubic meter in 2001 or 2002?

15 A. Would you clarify, any evidence or any data, is that  
 16 what --

17 Q. Yes.

18 A. No. The only data that exists that would be  
 19 applicable for your question is the monitoring data,  
 20 and the maximum short-term concentration that was  
 21 monitored in the vicinity of the plant was, I believe,  
 22 2,410, and that's below 3,000.

23 But, of course, the STEL is a 15-minute  
 24 period, and the 2,410 is over a one-hour period. So  
 25 as I talk about later in the report, there is

135

1 possibility that a 15-minute average, had it been  
 2 available, could have been above 3,000, even though  
 3 the 1-hour average was not.

4 Q. You reference in the third paragraph on this page,  
 5 that the ACGIH levels and values are -- the last  
 6 sentence of this paragraph -- often adopted by  
 7 authorities as standard including cognizant  
 8 authorities in the United States.

9 Do you know what authorities have adopted  
 10 the ACGIH, TLVs and STELs?

11 A. Well, I mean, typically OSHA, state agencies, and so  
 12 forth, will adopt them.

13 Q. Do you know of any --

14 A. Internationally, they are looked at quite closely as  
 15 well.

16 Q. Do you know of any authority who has adopted them as  
 17 safe levels for community exposure?

18 A. No. Typically, what a community level -- community  
 19 guideline or standard will do is take something like a  
 20 TLV, in the absence of any other standard, and then  
 21 apply a safety factor to it, typically a factor of 10.  
 22 And then use that as a health-based guideline, or I  
 23 wouldn't call it standard typically. So they are used  
 24 in that context, but they would not be simply taken  
 25 out and used one for one.

136

1 Q. Why is that factor of 10 generally used; do you know?

2 A. I didn't say it was generally used. There are  
 3 complications of factors that range from 1 to 2.5 to  
 4 10 to 100, and so forth. 10 is just an example of a  
 5 safety factor.

6 Typically, safety factors are used for a  
 7 variety of reasons, and it would depend on typically a  
 8 review of the individual situation that would include  
 9 the uncertainty associated with the health end point,  
 10 the significance of the health end point of whether  
 11 there was animal data that was the basis or human data  
 12 that was the basis of the TLV or other standard.

13 Many other factors would make the  
 14 determination what the appropriate safety factors  
 15 should be.

16 Q. Now, give you an example here where you could have a  
 17 very high peak concentration that, over a seven- or  
 18 eight-hour averaging period, actually yielded a low  
 19 concentration.

20 But is the opposite also true, if you had a  
 21 1-hour averaging time and your concentration for that  
 22 one-hour averaging time was 300 micrograms per cubic  
 23 meter, would that mean that the 15-minute averaging  
 24 time could be lower than that 300 micrograms per cubic  
 25 meter?

137

1 A. The maximum could not be lower, no. That's not a  
2 correct interpretation.

3 You have to think, if you will, of an hour  
4 being, say, broken into 4 quarters, each 15 minutes  
5 long. If your average over the 1-hour period is, for  
6 example, 300, which was the hypothetical you just  
7 placed to me --

8 Q. Uh-huh.

9 A. -- then at least 1 of those quarters would have to be  
10 above 300.

11 Q. That makes sense. 2.5.3, which is called reference  
12 levels -- reference exposure levels for H2SO4 are  
13 exceeded in the Cheshire community.

14 You are talking about these RELs, what  
15 exactly are these RELs?

16 A. Well, on the bottom of page 19, I define it,  
17 continuing on to 20, RELs defined as the concentration  
18 level at/or below which adverse health effects are  
19 anticipated for specified exposure duration.

20 Q. Those are community standards, then?

21 A. They are intended normally to be community standards,  
22 yes.

23 Q. In the next paragraph, you say: The most  
24 comprehensive assessment of RELs has been performed by  
25 the State of California.

138

1 Why do you say that that's the most  
2 comprehensive assessment?

3 A. Well, I haven't seen too many others assembled, for  
4 one thing, and California normally does a pretty  
5 consistent job, and their environmental staff are  
6 often leaders and, generally, what comes out is  
7 useful.

8 Q. Do you know if Ohio has any assessments of RELs, or  
9 has done any assessments?

10 A. I believe I searched and I didn't find anything;  
11 otherwise, I think I would have reported it.

12 Q. Does the exceedence of an REL inevitably mean an  
13 adverse health effect?

14 A. No. Exceedence of a concentration if no one is there,  
15 doesn't mean anyone is harmed, as we discussed  
16 yesterday.

17 Q. What if there is a healthy individual there. So that  
18 exceedence of that REL necessarily mean an adverse  
19 health effect if there is exposure?

20 A. For an individual case, I can't determine whether or  
21 not there would be an adverse health effect.

22 RELs are typically devised in a manner  
23 which it is believed, as was stated, that exceedence  
24 could cause an adverse health effect.

25 Individuals' sensitivity, vulnerability,

139

1 susceptibility, what you may -- whatever you may want  
2 to call that, is known to vary tremendously.

3 For example, asthmatics, we find often have  
4 responses to air pollutants to air levels that are far  
5 lower than what a healthy individual would have and,  
6 thus, community standards were typically designed to  
7 try to be protective of more susceptible members in  
8 the community.

9 This is well accepted and the basis, for  
10 example, of ambient air quality standards.

11 Q. Okay. Moving to 2.5.4, which is entitled Emergency  
12 Guidelines For H2SO4 Are Exceeded in the Cheshire  
13 Community.

14 You reference these AEGLs, and you  
15 reference an AEGL-1. There are actually AEGL-2s and  
16 3s, correct?

17 A. That's correct.

18 Q. Why don't you reference these in your report?

19 A. Well, a couple of reasons. First of all, AEGLs are,  
20 as I mentioned, exposure guidelines applicable to  
21 rare, maybe one-time-in-your-life events, like a fire  
22 explosion. They are not designed to provide a  
23 guideline value for a situation which might occur  
24 repeatedly over time.

25 And when I see an emergency situation, and

140

1 I mentioned, for example, a sulfur fire yesterday to  
2 you, it's very useful for professionals to have  
3 indications of what are emergency guideline levels so  
4 they can issue warnings like evacuate the area.

5 So these levels that are developed by NRC,  
6 EPA, and others, are essentially devised to provide  
7 that benchmark value for decisions of whether to  
8 evacuate, shelter in place, or do something else.

9 Q. Would you expect exceedence of AEGL-1 to prompt  
10 evacuation?

11 A. No. Typically, AEGL-1 would be -- let me retract  
12 that.

13 Evacuation is sought with all types of  
14 difficulties, and most of the emergency response  
15 professionals will know that you can cause a lot of  
16 damage by calling for an evacuation.

17 This kind of damage can include panic, it  
18 can cause people to be outdoors more, in buses and  
19 cars, or whatever, or largely unprotected against a  
20 toxic gas release. So it is with great reluctance  
21 that any firefighter, captain, whatever, would call  
22 for an evacuation. This is well understood.

23 So AEGL-1 would -- if it was felt it would  
24 not escalate into a more hazardous situation, would  
25 normally not call for an evacuation, rather than

141

1 something like shelter in place might be more  
2 appropriate. But it's really hard because it depends  
3 on the particulars in the particular scenario. You  
4 haven't specified the scenario. You have just said  
5 "in general."

6 Q. Are you aware of any circumstances where there was an  
7 evacuation after an exceedence of this AEGL level of  
8 H2SO4?

9 A. At Cheshire?

10 Q. Ever.

11 A. I haven't looked for that. As I indicated before, I  
12 would be surprised if it was called for.

13 Q. Let's look at 2.5.5, and then we can take a break  
14 before we go to 2.2.6.

15 A. You are making me go extra long this morning.

16 Q. We can take a break if you would like.

17 A. I'm fine.

18 Q. How would you define an adverse health impact?

19 MR. BAILEY: Are you asking him how he  
20 defines it?

21 MS. CRABTREE: Yes.

22 MR. BAILEY: Some of these questions...

23 A. I think in this case, what I have written here is that  
24 adverse health effect would include these cases  
25 including acute irritation, a change in pulmonary

142

1 above those that have been shown in well controlled,  
2 say, clinical settings to cause several health  
3 effects, adverse health effects.

4 We have visual evidence with this blue  
5 plume. We have modeling evidence that indicates  
6 levels can exceed 100 or, not more, micrograms.

7 Again, the totality of the evidence is that, in my  
8 opinion, there is a -- is consistent.

9 Q. You list some specific adverse health effects. I just  
10 want to cover a couple of these to make sure I'm clear  
11 on them. You have acute irritation, changes in  
12 pulmonary function.

13 What is a change in pulmonary function that  
14 would be a result of sulfuric acid exposure?

15 A. Well, for example, on a pulmonary function test where  
16 we are looking at the resistance and the flow of  
17 breathing, we will see substantial changes in those  
18 parameters.

19 Q. But, again, you haven't actually seen any of these  
20 tests run?

21 A. I haven't looked at the medical records, so I don't  
22 know if individuals in Cheshire actually had pulmonary  
23 function tests performed.

24 Q. What about altered -- I'm not going to get that  
25 right -- mucociliary clearance?

144

1 function, clearance of breathing, exacerbation of  
2 asthma. I would include all of these as adverse  
3 health effects.

4 BY MS. CRABTREE:

5 Q. If the health effect went away after a period of time,  
6 say an hour, or was a transitory effect, would you  
7 still consider it an adverse health effect?

8 A. I do consider that an adverse health effect.

9 Q. You say in 2.5.5 that the sulfuric acid releases have  
10 resulted in adverse health effects.

11 What specific evidence do you rely on for  
12 the fact that the sulfuric acid has resulted in those  
13 adverse health effects?

14 A. Well, first we have the symptomology of the  
15 individuals that's documented. I think that was in my  
16 report, a summary in Table 6; is that correct?

17 Q. I think it was 7.

18 A. You are correct, Table 7.

19 Q. Show that symptomology?

20 A. That's called symptomology --

21 Q. Uh-huh.

22 A. -- of what the people are experiencing as reported by  
23 their symptoms.

24 Second, we have limited, but useful in  
25 cases, monitoring data that indicates levels can go

143

1 A. Exactly.

2 Q. How do you define that?

3 A. This has to do with the removal of materials from the  
4 lung.

5 Q. How would you measure that?

6 A. This can be measured in some clinical tests.

7 Q. Again, you haven't seen any medical records or  
8 clinical tests from the CAP members or other Cheshire  
9 individuals?

10 A. No, I haven't.

11 Q. You mentioned exacerbation of asthma. What do you  
12 consider exacerbation of asthma?

13 A. Well, there are a number of ways to characterize  
14 exacerbation of asthma. You can look at  
15 symptomatology. You can use pulmonary function tests.  
16 You can use the frequency and severity of indicators  
17 like wheeze. You can look at asthma medications, the  
18 frequency and the cost of medications. You can look  
19 at emergency room visits. You can count asthma  
20 attacks; you can look at days home from school or work  
21 for children or adults respectively. There are many  
22 ways to look at exacerbation of asthma.

23 Q. But, again, not to be redundant, you haven't seen any  
24 medical records or clinical evidence of this?

25 A. In the Cheshire community, I have not.

145

1 Q. Okay. The last part of 2.5.5, you say that the Gavin  
2 facility will continue to represent an imminent and  
3 substantial endangerment to public health.

4 Is "imminent and substantial endangerment  
5 to public health" a toxicological term of art?

6 A. Can you clarify a toxicological term of art.

7 Q. Is a term of art to you, in your profession?

8 A. I'm not familiar with the word "term of art," the  
9 phrase of "term of art."

10 Q. Is it a common phrase in your profession?

11 A. The words "imminent," "substantial," are common.

12 Q. I'm talking about the phrase "imminent and substantial  
13 endangerment to public health."

14 A. To me, it's essentially recognizing -- well, your  
15 question was, is it common? I don't know. I have  
16 never researched whether this is common or not.

17 Q. I asked because it reflects some legal language in the  
18 statutes at issue. I wasn't sure if it was also a  
19 common phraseology in what you do.

20 If it's not, then I guess my next question  
21 to you is, what does this mean to you, imminent and  
22 substantial endangerment to public health?

23 A. To me, it means that there is a concern of substance  
24 that represents a public health threat; that actions  
25 should be taken to provide what I would consider

146

1 A. Sure. Do you need additional clarification beyond  
2 what's in the footnote?

3 Q. Let me ask you this: If you took the maximum  
4 ground-level concentration from the ISC modeling that  
5 you did, which was 130 micrograms per cubic meter,  
6 using your rollback method, what would the emission  
7 limit in grams per second or parts per million to keep  
8 emissions under 120 micrograms per cubic meter?

9 A. I would be very reluctant to approach it in that  
10 manner. The rollback can be based on modeling that  
11 way, but in the case where a model is performing  
12 poorly, you would be ill advised to do it that way.

13 Q. If you did do it that way, what would the new emission  
14 limit be?

15 A. That, I can't answer with much clarity either because  
16 I don't know, in fact, what the emissions of H2SO4  
17 precursors were that corresponded to the 2,410  
18 micrograms per cubic meter exceedence or measurement.

19 Q. But putting aside the 2,410 --

20 A. But I can't put that aside -- I'm sorry, let me hear  
21 you out.

22 Q. Okay. If the maximum concentration had been 130  
23 micrograms per cubic meter, what would the new  
24 emission limit need to be to keep emissions under the  
25 referenced exposure level of 120 micrograms per cubic

148

1 reasonably protective mitigation, or actions that are  
2 reasonably protected to mitigate the potential for  
3 health adverse -- you are getting me tongue-twisted --  
4 for adverse health effects.

5 MS. CRABTREE: Why don't we go ahead and  
6 take a break.

7 (A recess was taken)

8 BY MS. CRABTREE:

9 Q. Turning to 2.6 of your report, on page 21, where it  
10 starts -- entitled Recommendations to Minimize H2SO4  
11 Exposures and Risks. You recommend an emission limit  
12 of less than one part per million; is that correct?  
13 This is the first bullet point under 2.6.1.

14 A. No. As it stated, I recommended essentially a lower  
15 numerical and verifiable limit on emissions. And I  
16 didn't calculate the value exactly. Clearly there are  
17 a number of ways to calculate that, but if we wanted  
18 to keep ambient concentrations below an REL of  
19 approximately 120, I think this number would provide  
20 that.

21 Q. And that number being the 10 grams per second?

22 A. As an example of a number that would provide that.

23 Q. You footnote at the end of that bullet point, and can  
24 you walk me through this rollback method that you used  
25 to come to that limit?

147

1 meter?

2 A. That's what I thought you were going to say. I  
3 still -- I can't tell you precisely without making  
4 some assumption with respect to what the emission  
5 limits -- rather, what the emissions were during the  
6 time of the -- I'm sorry, the 100 -- I'm twisted now.

7 I would -- in the case of the modeling,  
8 where we assume in my modeling something on the order  
9 of 17 or 18 ppm, producing 130, we would need to  
10 reduce that by something on the order of 10 percent.  
11 Rather than being 17 or 18, it would be 15 or 16.

12 Q. Okay.

13 A. But, as I indicate, I would be reluctant to suggest  
14 that. So suggesting, that's an inappropriate  
15 methodology.

16 Q. On the fourth bullet point in this section, you say  
17 the numerical emission limit is better expressed as a  
18 maximum hourly emission rate rather than as a stack  
19 gas concentration.

20 Why is it better expressed as a maximum  
21 hourly emission rate?

22 A. For a couple of reasons, although it can be argued  
23 that you can derive it either way. But, typically,  
24 stack emission rates are provided in terms of a  
25 maximum rate in grams per second, grams per hour, tons

149

1 per year, and so forth.

2 This has the advantage of incorporating  
3 both what I would call the volumetric flow, in other  
4 words, in this Gavin facility, which is a base-load  
5 facility, but we have seen some degrees of ups and  
6 downs in terms of its power production. That emission  
7 limit expressed in terms of an hourly emission rate  
8 automatically accounts for those ups and downs. So  
9 it's preferred and commonly used that way in permit  
10 applications.

11 Q. Underneath that bullet point, you say that better  
12 control technology is available and feasible that can  
13 provide enhanced removals of SO<sub>3</sub>/H<sub>2</sub>SO<sub>4</sub> emissions and  
14 is currently installed at Gavin.

15 What are those control technologies?

16 A. Well, I didn't provide an extensive review of control  
17 technologies. I have examined a bit of the evidence  
18 with respect to the record at Gavin and, for example,  
19 I know that they tried additional approaches,  
20 including lower sulfur of coal. They are moving to  
21 lower catalysts. There was water injection, magnesium  
22 hydroxide injection, lime injection, trona injection.

23 Typically, the way I look at these things  
24 is as an optimization to try to provide combination of  
25 techniques that is effective. That's what they have

150

1 tried.

2 What they haven't tried are other types of  
3 systems to provide more effective SO<sub>3</sub>/H<sub>2</sub>SO<sub>4</sub> control.  
4 For example, wet scrubbers are also known to provide  
5 higher removals.

6 Q. Wet scrubbers?

7 A. Wet precipitators, I'm sorry.

8 Q. Wouldn't a wet -- an ESP is an electrostatic  
9 precipitator, is that what you are talking about?

10 A. Yes.

11 Q. I have heard them referred to as wet ESPs.

12 A. Wet ESPs, yes. They already have a sulfur scrubber at  
13 Gavin.

14 Q. Wouldn't a wet ESP actually reduce the exit  
15 temperature of the plume?

16 A. As I indicated, they approach these things as a  
17 system. The temperatures that are passed through the  
18 ESP are a function of many operating parameters. So  
19 you might make adjustments elsewhere in the system to  
20 maintain temperatures at some potential, what you feel  
21 is acceptable.

22 Currently the temperatures at Gavin stack  
23 are very low. In the modeling, I think we used  
24 temperatures of 120 or 130. It would be not difficult  
25 to adjust the process conditions to get temperatures

151

1 that are higher or lower from that.

2 Again, in terms of considering the overall  
3 system design, I would be concerned about performance  
4 of the pollution controls. I would be concerned about  
5 the impact on plant efficiency. I would be concerned  
6 about a number of different factors. I would approach  
7 it as a systems problem.

8 Q. Other than wet ESPs, what other control technology do  
9 you feel the plant has not tried?

10 A. Those are the things that come to mind right now.

11 Q. You say that these control technologies are feasible.  
12 Have you done any feasibility study?

13 A. No, I haven't done a feasibility study.

14 Q. Have you evaluated any cost to install or maintain any  
15 of these suggestions that you make?

16 A. I have seen some numbers in the record that examine  
17 cost of some of these things and -- but I haven't seen  
18 what I would consider to be a systematic assessment of  
19 the -- of the technical options.

20 Q. Did you make any assessment of whether any of these  
21 options would have any ancillary emission impacts?  
22 And I will give you an example: When the SCR went  
23 into service to reduce nitrogen dioxides, there was an  
24 increase in the SO<sub>3</sub>/H<sub>2</sub>SO<sub>4</sub> that we are talking about  
25 today. Would any of these options that -- have you

152

1 looked at any of the options that you suggest to see  
2 if there would be similar ancillary impacts on  
3 emissions?

4 A. Well, there are interactions between these things, and  
5 again, I'm coming back to the systems perspective  
6 because typically you look at a facility as a whole.

7 And I understand that injections of  
8 different materials can affect, for example, particle  
9 resistivity, which influences efficiency of your  
10 particular removal device if you are using an ESP.  
11 But I haven't done a systematic assessment.

12 In particular, that's one of the reasons  
13 this case is interesting, because it provides a -- it  
14 demonstrates the complexities that occur when you  
15 don't necessarily have a systematic view of emissions  
16 and, you know, the kinds of outcomes that can result.

17 Q. You mentioned earlier that it would not be difficult  
18 to get higher exit temperatures. What would you do to  
19 get those higher exit temperatures?

20 A. At Gavin?

21 Q. Yes.

22 A. Well, I haven't done an engineering analysis at Gavin.  
23 I mean, I have various parameters that they can  
24 control to affect temperatures. They have various  
25 feed rates that they can control to affect

153

1 temperatures, and so forth.

2 My experience is that other utilities have

3 in the past altered temperatures for various reasons.

4 And Gavin doesn't seem to be any different from that

5 and, certainly, they understand that, how to do this.

6 Q. You have said that temperatures have been adjusted in

7 the past, that you have seen. On what -- by how much?

8 A. I can't recall offhand numerical value at specific

9 locations in the facility. I mean, temperatures at

10 this facility range from, you know, very, very hot at

11 the boiler to just a little bit above ambient

12 temperature at the stack. So, I mean, it depends

13 where you are talking, and so forth.

14 For example, a facility like this will

15 adjust conditions to reduce slagging issues, and so

16 forth, on a fairly routine basis. If they are finding

17 that temperatures drop at a location where it's

18 important to maintain a temperature for some process

19 condition, they will adjust that. So these things are

20 done quite routinely.

21 I don't know what capabilities they have

22 numerically, but they certainly have the ability to do

23 that. That's critical for the operation of this kind

24 of facility.

25 Q. In this, you mentioned the use of higher quality coal.

154

1 What do you mean by higher quality coal?

2 A. This is largely referring to the sulfur content of the

3 coal.

4 Q. Okay. As a sulfur content goes down -- let me

5 rephrase that.

6 Are you aware of any equipment difficulties

7 with using low-sulfur coal at plants that were

8 designed to burn high-sulfur coal?

9 A. Yeah. In particular, in this case, I believe the

10 deposition of Osborn has a discussion that the

11 lower-sulfur coal -- I'm not sure if that was Wyoming

12 coal -- but produced, I think it was slagging

13 problems, but I'm not sure how much this was actually

14 investigated.

15 Typically in a facility like this, you want

16 it to last for many, many years. You make

17 short-term tests. You make some short-term

18 corrections, but it does take some time to sort of get

19 the process down and it operates in the kind

20 reliability we like to see for base-loading

21 facilities, which is very high standards to

22 obtain -- to maintain, rather.

23 But it's not clear to me that that couldn't

24 be achieved with a use of a different coal, from the

25 high-sulfur coal.

155

1 Q. Is it your opinion that it's possible for a coal-fired

2 facility with a scrubber and SCR to achieve emissions

3 of 1 part per million of SO3?

4 A. I don't know. I have seen -- I would say -- I would

5 characterize no consistent information on -- I

6 wouldn't say consistent, but representative emission

7 information on SO3.

8 My expectation is that given the fact that

9 SO3 removals haven't been routine, that knowing on the

10 order of a percent or so of sulfur in a typical boiler

11 will be converted to SO3, and knowing that certain

12 removals, depending on the specifics of the plant,

13 what kind of pollution-control system, that there will

14 be a certain fraction of SO3 emitted.

15 My guess is probably that this limitation

16 of 10 grams per second -- is that the one you are

17 referring to?

18 Q. Uh-huh.

19 A. Would be difficult to achieve at a large facility like

20 Gavin.

21 Q. Turning to page 22, we talked about you -- you talk

22 about monitoring plan here. And we talked about that

23 a little bit yesterday, as to how you would have

24 changed the ambient monitoring plan. But in 2.6.2,

25 it's entitled Additional Measures to Mitigate

156

1 Exposures and Risks.

2 Before the bullet points, one of the things

3 you identify is exhaust gas reheat and increase stack

4 velocity -- stack gas velocity.

5 What is involved in achieving increased

6 stack gas velocity?

7 A. I'm sorry, which bullet points?

8 Q. Right under the italicized portion.

9 A. Got it. Your question was?

10 Q. What exactly is involved in achieving increased stack

11 gas velocity?

12 A. I don't know the details at Gavin but, typically, you

13 have fans that might have to be run at a higher power

14 to produce a greater velocity.

15 Q. Anything else?

16 A. At Gavin, I don't know the specifics that would be

17 involved.

18 Q. Okay.

19 A. There could be redesign of the stack, or the

20 termination of the stack but -- and that might have

21 some other engineering consequences. Again, I don't

22 know the specifics at Gavin.

23 Q. Moving to your bullet points on this page, the first

24 bullet point says: Continuous observation and

25 monitoring of conditions in the area. What do you

157

1 mean by that?

2 A. Well, there are a couple of things. As I stated here

3 at the onset, I didn't provide a comprehensive

4 assessment of all the additional mitigating measures

5 that might be used. That's a -- that requires more

6 analysis, which I simply didn't have time to provide.

7 As other pollutants, typically we try to

8 measure them continuously so that we understand the

9 kinds of concentrations that are likely to occur.

10 In a case of a power plant, the typical

11 type of monitoring that work that might be used could

12 include sighting of continuous monitors at what we

13 call hot spots of locations where plume touchdowns, if

14 you will, are likely to occur. It might include

15 locations that are where populations are most likely.

16 Those would be considered population-oriented sites.

17 It might include background sites to get at

18 the question as to whether there are other sources

19 that might provide, in this case, H2SO4 exposure. So

20 this is just an example of the way that you would try

21 to develop a spacial and temporal understanding of the

22 pollutant levels for the purpose of, well, you know,

23 protecting public health and understanding things like

24 frequency of plume touchdowns.

25 Q. Okay. You go through and identify several suggestions

158

1 here. Are you saying that the types of suggestions

2 that you are looking at here, and some of them are

3 pager alerts, you mentioned before the SMS text on

4 phone, sirens, websites.

5 Are you saying that these should be put in

6 place to warn residents anytime that emissions from

7 the Gavin facility exceed 10 grams per second?

8 A. There is really two parts to my answer. First is, I'm

9 not saying that specifically these are the appropriate

10 measures that should be used. I said, in the first

11 case, these are measures that might be used. And it

12 would be based on what local individuals feel is

13 appropriate, what is feasible to do, and many other

14 considerations.

15 For example, I don't know definitively that

16 people have e-mail; or if they don't have e-mail,

17 e-mail is not appropriate.

18 The second part is, the emission limit is

19 designed to be protective in ensuring with a high

20 degree of likelihood that there will not be high

21 concentrations in the area. And if you had emissions

22 as low as, for example, 10, then most likely you would

23 not have plume touchdowns that would result in high

24 levels of H2SO4 and adverse health effects.

25 As I state, I think in the italicized part,

159

1 that these measures will be especially important if

2 emission limits do not approach that level. And I

3 would infer, and I would ask you to infer from that,

4 then with low levels of emissions, these measures

5 would not be necessary.

6 Q. When you said 10, you meant 10 grams per second?

7 A. 10 grams per second.

8 Q. Not 10 parts per million?

9 A. That's correct. That's stated in the written record,

10 but I need to say it.

11 Q. I just want us to be clear.

12 You don't necessarily have an opinion as

13 far as which of these measures should be used, but

14 they are more of suggestions of things that could be

15 used?

16 A. Well, I stated yesterday that the primary intent of

17 this report was not to design these measures; instead,

18 it was to do a couple of other things. But I do have

19 some opinions about what I think would be appropriate

20 and useful.

21 Q. What are those, or what is that?

22 A. Well, there are a number of them. And they are

23 certainly going to include better monitoring, and

24 potentially some of the other points as well.

25 Q. Which other points?

160

1 A. Well, I haven't thought about the others in much

2 detail yet for the purpose of your question.

3 I think it's actually quite appropriate to

4 provide some sort of warning system to residents, and

5 which is appropriate, I can't say offhand because I

6 don't know the community that well. But certainly, as

7 I have noted here on page 22, including the footnote,

8 these types of strategies are becoming commonly

9 employed in areas that have problems meeting

10 air-quality levels that are protective.

11 And as an example, in Michigan, we have

12 e-mails that are sent out. We have websites where you

13 can see alerts. We have a variety of mechanisms aimed

14 at alerting especially susceptible individuals not to

15 go outside, limit their outdoor activity. It's on the

16 radio and elsewhere. These are inexpensive and they

17 can be effective.

18 In a case of the Cheshire situation where

19 you have a fairly major road going through the area,

20 the possibility of acute effects for individuals

21 driving through, it's a little more problematic.

22 Cars, even with windows closed, don't

23 provide tremendous attenuation of pollutants; in other

24 words, pollutant concentration outside the vehicle is

25 typically not all that much different from the

161



1 concentration in the cabin of the vehicle. And this  
2 applies in cars even if you have the windows closed,  
3 and so forth. It helps a little bit but not a lot.  
4 That's a bit more problematic to deal with.

5 And I don't know how to address that sort  
6 of situation, or other inadvertent exposure, except by  
7 limitations that essentially remove the source of the  
8 problem.

9 Also, I would have to say that the  
10 philosophy of air quality and public protection is to  
11 put the burden on the polluter and that responses like  
12 requesting the individuals to wear personal protective  
13 equipment is generally not the desirable strategy.

14 Q. What personal protective equipment would that be for  
15 sulfuric acid?

16 A. For example, you might wear a mask which neutralizes  
17 the acid. It's not very appropriate, in my opinion,  
18 to ask people to wear those masks while they are  
19 exercising.

20 Q. What ambient level would you consider high enough to  
21 prompt an evacuation of Cheshire?

22 A. An evacuation of Cheshire?

23 Q. Yes.

24 A. For H2SO4?

25 Q. Yes.

162

1 A. I would go back to some of the emergency response  
2 guideline limit values, and I think, as you indicated,  
3 I didn't provide what the second levels were in this  
4 report, and offhand I don't recall what they are  
5 either. It's likely to be on the order of 1,000 or  
6 several thousand.

7 Q. So that second level would be a good guideline for  
8 evacuation?

9 A. That would be a guideline. There are a number of  
10 guidelines that are available.

11 There are a couple of other limits that are  
12 cited in my report and, in fact, you know, the NRC has  
13 levels here of 1,000, 2,000, 5,000. This depends on  
14 the duration of exposure, as I mentioned to you, and,  
15 you know, we understand that the -- if it is a  
16 duration that is likely to be long, then things like  
17 sheltering in place may not be very effective. And so  
18 if the duration is long, we might consider a lower  
19 number to be appropriate. If the duration is short,  
20 we might expect a higher number to be appropriate.  
21 And, in part, that's the reason for the multitude of  
22 guideline limits and emergency limits that we have.

23 You know, most of the numbers are in the  
24 thousands of range; and how many thousands, 1,000 or  
25 5,000, it depends on a number of factors.

163

1 Q. You mentioned yesterday, when you were at the plant  
2 for a site visit that you saw a tinge of blue plume.  
3 Did you experience any health effects when you were  
4 there?

5 A. Yes.

6 Q. What health effects did you experience?

7 A. In climbing up the boiler, it was very hot, but I was  
8 far out of the plume and I was sweating profusely, but  
9 I had no effects due to the H2SO4.

10 Q. Are there any opinions that you plan to offer that are  
11 not contained in your report or that we have talked  
12 about in the past two days?

13 A. That I will offer when and where?

14 Q. If the case were to go to trial, in your testimony.

15 A. Possibly, sure.

16 Q. What other opinions are those?

17 A. Well, first of all, it would depend on what I was  
18 asked, I think.

19 Q. Are there any specific additional opinions other than  
20 what is in your report and that we have talked about,  
21 that you plan to offer at trial in this case?

22 A. The only one that comes to mind right now is the  
23 Valburg's report on mine -- discusses the  
24 epidemiological evidence, and I didn't provide any  
25 depth on that in this report. And so that's one area

164

1 which could come up which I might have an opinion on.

2 Q. Were you asked to prepare a rebuttal report?

3 A. No, I don't think I have.

4 Q. Did you know that you had an opportunity to prepare a  
5 rebuttal report?

6 A. I think Jim Hecker and I discussed the possibility.

7 MS. CRABTREE: If we can just have two  
8 minutes, I think I'm done.

9 (Discussion off the record)

10 MS. CRABTREE: I thank you for your time,  
11 Dr. Batterman. That's all the questions I have for  
12 you.

13 THE WITNESS: Thank you.

14 MR. BAILEY: We are done. We will read it.

15 (Deposition concluded at 11:05 a.m.)

16 Signature of the witness was requested)

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165

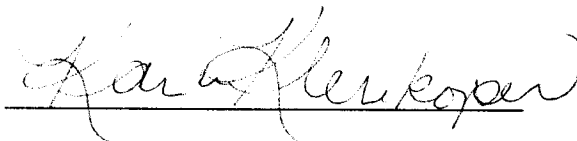
CERTIFICATE OF NOTARY

STATE OF MICHIGAN )

) SS

COUNTY OF OAKLAND )

I, Karen Klerekoper, a Notary Public in  
and for the above county and state, do hereby certify  
that the above deposition was taken before me at the  
time and place hereinbefore set forth; that the  
witness was by me first duly sworn to testify to the  
truth, and nothing but the truth; that the foregoing  
questions asked and answers made by the witness were  
duly recorded by me stenographically and reduced to  
computer transcription; that this is a true, full and  
correct transcript of my stenographic notes so taken;  
and that I am not related to, nor of counsel to either  
party nor interested in the event of this cause.



Karen Klerekoper, CSR-4250, RPR

Notary Public,

Oakland County, Michigan

My Commission expires: 10/7/06

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Date: 6/19/06

TO : Molly S. Crabtree  
Porter, Wright, Morris, and Arthur

Re: CASE: Cap v. Ohio Power Company

DEPONENTS: Stuart Batterman, Ph.D

DATE: 1/5/06, 1/6/06

Enclosed please find the original transcripts of the above deposition(s) and attendant exhibits, if any.

☐ The errata sheet and signature page are enclosed.

☒ There has been no response from the witness. We are forwarding the original to you, assuming that signature has been waived.

Sincerely,

Patricia Murray & Associates